

CLAIMS

What is claimed is:

1. An optical pickup comprising:

at least one light source;

at least one light splitting device which splits light from the light source into a main beam and four or more sub beams symmetrical with respect to the main beam, which are then emitted on an optical data storage medium, wherein the four or more sub beams include two first sub beams located close to the main beam and two second sub beams located away from the main beam; and

at least one photodetecting device, which receives the main and sub beams reflected off the optical data storage medium;

wherein where phase differences between the two first sub beams and between the two second sub beams are PH1 and PH2, respectively, the first and second sub beams are emitted on the optical data storage medium so that PH1 and/or PH2 satisfy Equations (1) and/or (2) given below, respectively, and a tracking error signal is detectable by a differential push-pull (DPP) method using the main beam and the two first sub beams and the main beam and the two second sub beams for $\pm R/RW$ and RAM type optical data storage media, respectively:

$$181.5^{\circ} \leq PH1 \leq 211.5^{\circ}$$

(1)

$$148.3^{\circ} \leq PH2 \leq 181.7^{\circ}$$

(2)

2. The optical pickup of claim 1, wherein the photodetecting device comprises a main photodetector receiving the main beam, a pair of first sub photodetectors receiving the first sub beams, and a pair of second sub photodetectors receiving the second sub beams.

3. The optical pickup of claim 2, wherein each of the first and second sub photodetectors is divided into two or more sections.

4. The optical pickup of claim 3, wherein the main photodetector is divided into four or more sections.

5. The optical pickup of claim 4, wherein either second sub photodetector is divided into four or more sections.

6. The optical pickup of claim 1, wherein the light splitting device is a diffractive optical element that diffracts the light from the light source into a plurality of beams including a zero-order beam and plus and minus first- and second-order beams, and the main beam, the two first sub beams, and the two second sub beams are the zero-order beam, the plus and minus first-order beams, and the plus and minus second-order beams, respectively.

7. The optical pickup of claim 1, wherein beams having a plurality of different wavelengths are used to record on and/or reproduce from a plurality of different types of optical data storage media that are compatible with one another.

8. The optical pickup of claim 7, wherein recording and/or reproduction is made on and/or from at least some of CD-ROM/R/RW and at least some of DVD-ROM/ \pm R/RW/RAM that are compatible with one another.

9. The optical pickup of claim 1, wherein at least some of DVD-ROM/ \pm R/RW/RAM and/or at least some of CD-ROM/R/RW are recorded on and/or reproduced from.

10. The optical pickup of claim 1, wherein the RAM type optical data storage medium is a DVD-RAM optical data storage medium, and the \pm R/RW type optical data storage medium is a DVD \pm R/RW optical data storage medium and/or a CD-R/RW optical data storage medium.

11. An optical recording and/or reproducing apparatus, comprising:

an optical pickup comprising at least one light splitting device, which splits light from at least one light source into a main beam and four or more sub beams symmetrical with respect to the main beam, which are then emitted on an optical data storage medium, wherein the four or more sub beams include two first sub beams located close to the main beam and second two sub beams located away from the main beam, at least one photodetecting device, which receives the main and the first and second sub beams reflected off the optical data storage medium,

wherein where phase differences between the two first sub beams and between the two second sub beams are PH1 and/or PH2, respectively, the first and second sub beams are emitted on the optical data storage medium so that PH1 and PH2 satisfy Equations (1) and/or (2) given below, respectively, and a tracking error signal is detectable by a differential push-pull (DPP) method using the main beam and the two first sub beams and the main beam and the two second sub beams for $\pm R/RW$ and RAM type optical data storage media, respectively:

$$181.5^{\circ} \leq PH1 \leq 211.5^{\circ}$$

(1)

$$148.3^{\circ} \leq PH2 \leq 181.7^{\circ}$$

(2); and

a signal processor designed to detect a tracking error signal by the differential push-pull (DPP) using detection signals of the main and the two first sub beams and the two of the main and second sub beams for $\pm R/RW$ and RAM type optical data storage media, respectively.

12. The optical recording and/or reproducing apparatus of claim 11, wherein the photodetecting device comprises a main photodetector receiving the main beam, a pair of first sub photodetectors receiving the first sub beams, and a pair of second sub photodetectors receiving the second sub beams.

13. The optical recording and/or reproducing apparatus of claim 12, wherein each of the first and second sub photodetectors is divided into two or more sections.

14. The optical recording and/or reproducing apparatus of claim 13, wherein the main photodetector is divided into four or more sections.

15. The optical recording and/or reproducing apparatus of claim 14, wherein either second sub photodetector is divided into four or more sections.

16. The optical recording and/or reproducing apparatus of claim 15, wherein the signal processor detects a focus error signal by a differential astigmatic method using detection signals from the main and the two second sub photodetectors for a RAM type optical data storage medium.

17. The optical recording and/or reproducing apparatus of claim 11, wherein the light splitting device is a diffractive optical element that diffracts the light from the light source into a plurality of beams including a zero-order beam and plus and minus first- and second-order beams, and the main beam, the two first sub beams, and the second sub beams are the zero-order beam, the plus and minus first-order beams, and the plus and minus second-order beams, respectively.

18. The optical recording and/or reproducing apparatus of claim 11, wherein the optical pickup uses beams having a plurality of different wavelengths to record on and/or reproduce from a plurality of different types of optical data storage media that are compatible with one another.

19. The optical recording and/or reproducing apparatus of claim 18, wherein recording and/or reproduction is made on and/or from at least some of CD-ROM/R/RW and at least some of DVD-ROM/ \pm R/RW/RAM that are compatible with one another.

20. The optical recording and/or reproducing apparatus of claim 11, wherein at least some of DVD-ROM/ \pm R/RW/RAM and/or at least some of CD-ROM/R/RW are recorded on and/or reproduced from.

21. The optical recording and/or reproducing apparatus of claim 11, wherein the RAM type optical data storage medium is a DVD-RAM optical data storage medium, and the \pm R/RW type optical data storage medium is a DVD \pm R/RW optical data storage medium and/or a CD-R/RW optical data storage medium.

22. A method of realizing a tracking servo that is compatible between different types of optical data storage media, the method comprising:

splitting light from a light source into a main beam and four or more sub beams symmetrical with respect to the main beam, wherein the four or more sub beams include two first sub beams located close to the main beam and two second sub beams located away from the main beam, and where phase differences between the first sub beams and/or between the second sub beams are PH1 and/or PH2, respectively, emitting the first and second sub beams on an optical data storage medium in such a manner that PH1 and/or PH2 satisfy Equations (1) and/or (2) given below, respectively:

$$181.5^{\circ} \leq PH1 \leq 211.5^{\circ}$$

(1)

$$148.3^{\circ} \leq PH2 \leq 181.7^{\circ}$$

(2);

detecting the main and sub beams reflected off the optical data storage medium to result in detection signals; and

detecting a tracking error signal by differential push-pull (DPP) using the detection signals resulting from the main and first sub beams and from the main and second sub beams for \pm R/RW and RAM type optical data storage media, respectively.

23. The method of claim 22, wherein the detection of the tracking error signal comprises:

determining whether detection signals of the main and the first sub beams or the main and the second sub beams will be used for detecting the tracking error signal according to an optical data storage medium type signal detected by an optical recording and/or reproducing apparatus; and

detecting the tracking error signal suitable for the type of optical data storage medium by DPP and outputting the same.

24. The method of claim 22, wherein the main beam, the two first sub beams, and the two second sub beams are a zero-order beam, plus and minus first-order beams, and the plus and minus second-order beams, respectively, all of which are split by a diffractive optical element.

25. The method of claim 22, wherein the RAM type optical data storage medium is DVD-RAM optical data storage medium, and the $\pm R/RW$ type optical data storage medium is DVD $\pm R/RW$ and/or CD-R/RW optical data storage medium.

26. A compatible optical pickup reading from an optical disc, comprising:
a light source emitting light;
a light splitter which splits the light into a main beam and four sub beams;
an optical path changing means for changing the path of the main beam and the four sub beams to and from the optical disc;
a photodetector detecting the reflection signals from the main beam and each of the four sub beams, the photodetector comprises
a main photodetector detecting a main detection signal from the main beam reflected by the optical disc;
a first and second sub photodetector detecting a first pair of the four sub beams closest to the main beam reflected by the optical disc; and
a third and fourth sub photodetector detecting a second pair of the four sub beams furthest from the main beam reflected by the optical disc,
wherein a tracking error signal is detectable based on the reflection signals of the main beam and each of the four sub beams based on a type of the optical disc and a phase between the first pair of the four sub beams and between the second pair of the four sub beams is adjustable by rotating the light splitter.

27. The pickup of claim 26, wherein the main beam corresponds to a zero order beam, the first pair corresponds to a plus and minus first order beam, respectively, and the second pair corresponds to a plus and minus second order beam, respectively.

28. The pickup of claim 27, wherein the phase between the plus and minus first order beams and the phase between the plus and minus second order beams is adjusted so that:

$$181.5^{\circ} \leq PH1 \leq 211.5^{\circ}$$

$$148.3^{\circ} \leq PH2 \leq 181.7^{\circ}$$

where PH1 is the phase between the plus and minus first order beams, and PH2 is the phase between the plus and minus second order beams.

29. The pickup of claim 27, wherein the main photodetector comprises four divided regions, the first photodetector and the second photodetector each comprises two divided regions, and the third photodetector and the fourth photodetector each comprises four divided regions, wherein the first and third photodetectors and the second and fourth photodetectors are respectively disposed at opposite sides of the main photodetector.

30. The pickup of claim 29, further comprising:
a switching circuit selectively connecting the first, second, third and fourth photodetectors to a signal processor which detects the tracking error signal by a differential push-pull (DPP) method.

31. The pickup of claim 30, wherein the phase between the first pair of the four sub beams and the phase between the second pair of the four sub beams is set so that:

$$181.5^{\circ} \leq PH1 \leq 211.5^{\circ}$$

$$148.3^{\circ} \leq PH2 \leq 181.7^{\circ}$$

where PH1 is the phase between the first pair of the four sub beams, and PH2 is the phase between the second pair of the four sub beams.

32. The pickup of claim 31, wherein when the type of the optical disc is $\pm R/RW$, the controller causes the switching circuit to connect the first and second photodetectors to the signal processor.

33. The pickup of claim 31, wherein when the type of the optical disc is RAM, the controller causes the switching circuit to connect the third and fourth photodetectors to the signal processor.